# AN EVALUATION OF NITROGEN APPLICATION METHODS FOR RIDGE-PLANTED CORN[1]

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Ridge planting is a conservation tillage method receiving some attention in the Midwest at the present time. In this system the crop is planted atop a ridge which was formed by cultivation of the previous year's crop. There is generally no tillage performed between ridge building and the next year's planting. The system is similar to no-till in that large quantities of residue are often present on the soil surface in the spring, most being concentrated in the ridge furrows.

Research initiated in the early 1980s has demonstrated that ridge planting is a viable option for corn production on the poorly-drained lake plain soils of northwest Ohio (Eckert, 1987a,b). In these early trials, the bulk of nitrogen (N) was applied either as anhydrous ammonia (AA,82-0-0) injected into the ridge furrows or as urea-ammonium nitrate solution (UAN,28-0-0) dribbled onto the ridge as a sidedress treatment. Some broadcast UAN was also applied in both cases as a "starter". These systems were chosen because of their applicability to no-till corn production. However, as interest in ridge planting grew, farmers began to inquire about other methods of N application. This study was conducted from 1985 through 1987 to evaluate several other application programs.

The study was conducted on a tile-drained Hoytville silty clay (Mollic Ochraqualfs) located at the Ohio Agricultural Research and Development Center Northwest Branch. Corn (Beck's 65X) was planted 1.5 inches deep into soybean residue on ridges each year, in late April, and at a rate of 30,000 seeds/A. Ridges were reformed by cultivation in mid-June each year, both in the corn and in the soybeans which would provide residue for the next year's corn crop. Plots measured 10x90 feet. The center two rows of each four-row plot were machine-harvested for yield at or after physiological maturity.

Each plot except 0 N check plots received 150 lb N/A in the following manners:

1. 125 lb N/A as AA injected in ridge furrows between rows 1 and 2, and 3 and 4, using dual knives spaced 10" apart, plus 25 lb N/A as broadcast UAN, all at planting

2. 150 lb N/A as UAN broadcast at planting

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3. 125 lb N/A as UAN dribbled either on each ridge (6" from row), in each ridge furrow, or in alternate ridge furrows (same furrows as AA), plus 25 lb N/A as UAN broadcast, all at planting

4. 50 lb N/A as UAN broadcast at planting plus 100 lb N/A as UAN dribbled either onto ridge (6" from row) or in ridge furrows immediately after cultivation

No growing season produced excess soil moisture conditions lasting for any extended period of time. The 1985 season was rather non-descript. The 1986 season was regarded by many local farmers as the best they could ever remember, while in 1987 crop yields were limited by extreme mid- and late-season moisture stress. Despite such differences in growing seasons, the trends in yield were rather consistent in all three years.

Table 1. shows crop performance data averaged over the three-year period. These data should be interpreted in light of some variation in treatment performance between years; however the three-year averages do give an idea of cumulative performance over time, and there were really no extreme changes in ranking of treatments from year to year (Tables 2-4).

Corn grown using anhydrous ammonia produced the highest yields when averaged over three years. This material also produced the highest ear leaf and grain N concentrations. Broadcast UAN and split UAN dribble-sidedressed on the ridge produced comparable yields and ear leaf N concentrations, somewhat lower than ammonia, but higher than other treatments. All other treatments produced lower yields and ear leaf N concentrations than the above-mentioned ones. Grain N concentrations were lower in all UAN than ammonia treatments; however, sidedressing on the ridge produced higher concentrations than the other UAN treatments. Nitrogen removed from the soil by the crop was highest in ammonia treatments, second highest for the UAN sidedressed-on-ridge treatment, and lower for all others.

In 1985 and 1986, when moisture was not severely limiting, placing UAN in ridge furrows produced yields inferior to other treatments (Tables 2 and 3). In these two years, split UAN sidedressed on the ridge was perhaps slightly more consistent than broadcasting, as evidenced by the large decline in yields in the broadcast treatment in 1986. In both years, yields were generally related to ear leaf N concentrations, with higher concentrations leading to higher yields.

In the very dry year, 1987 (Table 4), ammonia produced higher ear leaf N concentrations but lower yields than the broadcast UAN treatment ($P<.10$). Total N removal by grain in the ammonia treatment was similar to that in the broadcast UAN treatment (83 v. 84 lb N/A), despite a higher grain N concentration in the former. Ammonia-treated plots appeared more vigorous during the early growing season. It is possible that plants treated with ammonia exhausted soil moisture reserves earlier in the season and consequently suffered greater moisture stress later or that the less-mobile ammonia was at a positional disadvantage during the dry latter part of the season, or both. Similar observations have been made previously in regular, non-ridged no-till corn plots at other locations in Ohio (Eckert, 1987c).

Regardless of the nature of the effect, it seems that late-season moisture stress reduces the yield-producing potential of anhydrous ammonia relative to broadcast UAN.

Overall results of the study indicated that placing UAN in the furrows of ridge-planted fields will probably result in lower corn yields than might be produced with other N management programs. This may be due to immobilization of N within the relatively heavy residue cover which accumulates in the ridge furrows. A high denitrification potential in the ridge furrows cannot be disregarded as another possible cause of results; however soil conditions were generally dry throughout the study period and denitrification was not considered to be a major problem in this particular

The failure of the dribbled-on-ridge at planting UAN treatment to produce more competitive yields is difficult to explain. It may be that this placement concentrated N in a relatively dry portion of the root zone for too long a period during the early growing season. Nitrogen deficiency during vegetative growth, relative to other treatments, was indicated by lower ear leaf N concentrations. This treatment is often regarded as a satisfactory method of applying UAN to no-till corn; however, the soil environment in ridge planting may be different enough to render it rather ineffective as a practice for ridge-planted corn.

## REFERENCES

Eckert, D.J. 1987a. Evaluation of ridge planting systems on a poorly drained lake plain soil. J. Soil and Water Cons. 42:208-211.

Eckert, D.J. 1987b. Ridge planting on poorly drained soils. Proc. 3rd International Workshop on Land Drainage. Columbus, Ohio. Dec.7-11, 1987. The Ohio State University.

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Table 1. Effect of different N management programs on corn grain yield, ear leaf and grain N concentrations, and N removed in grain, 1985-1987.

| Treatment | Yield | Ear leaf N | Grain N | N Removed |
| --- | --- | --- | --- | --- |
| | bu/A | ------- % | ------ | lb/A |
| Check (no N) | 91 | 2.46 | 1.14 | 49 |
| Ammonia & UAN | 149 | 3.34 | 1.60 | 110 |
| UAN broadcast | 139 | 3.23 | 1.44 | 91 |
| UAN dribbled | | | | |
| On ridge | 129 | 3.08 | 1.39 | 82 |
| Each furrow | 126 | 3.09 | 1.40 | 81 |
| Alternate furrows | 124 | 3.08 | 1.37 | 78 |
| UAN split | | | | |
| Sidedress-ridge | 140 | 3.21 | 1.52 | 99 |
| Sidedress-furrow | 128 | 3.11 | 1.42 | 84 |
| $LSD_{.05}$ | 7 | 0.09 | 0.05 | 6 |
| $LSD_{.10}$ | 6 | 0.07 | 0.04 | 5 |

Table 2. Effect of different N management programs on corn yield, and ear leaf and grain N concentrations, 1985.

| Treatment | Yield | Ear leaf N | Grain N |
| --- | --- | --- | --- |
| | bu/A | ---------- % | ---------- |
| Check (no N) | 100 | 2.18 | 1.08 |
| Ammonia & UAN | 172 | 2.93 | 1.43 |
| UAN broadcast | 162 | 2.92 | 1.33 |
| UAN dribbled | | | |
| On ridge | 148 | 2.76 | 1.23 |
| Each furrow | 148 | 2.63 | 1.25 |
| Alternate furrows | 154 | 2.71 | 1.25 |
| UAN split | | | |
| Sidedress-ridge | 160 | 2.89 | 1.42 |
| Sidedress-furrow | 152 | 2.85 | 1.31 |
| $LSD_{.05}$ | 11 | 0.19 | 0.08 |
| LSD.10 | 9 | 0.16 | 0.07 |

Table 3. Effect of different N management programs on corn yield, and ear leaf and grain N concentrations, 1986.

| Treatment | Yield | Ear leaf N | Grain N |
|---|---|---|---|
| | bu/A | ---------- % | ---------- |
| Check (no N) | 103 | 2.98 | 1.12 |
| Ammonia & UAN | 176 | 3.41 | 1.56 |
| UAN broadcast | 146 | 3.35 | 1.30 |
| UAN dribbled | | | |
| On ridge | 141 | 3.11 | 1.31 |
| Each furrow | 130 | 3.16 | 1.24 |
| Alternate furrows | 122 | 3.15 | 1.22 |
| UAN split | | | |
| Sidedress-ridge | 160 | 3.41 | 1.45 |
| Sidedress-furrow | 144 | 3.38 | 1.40 |
| $LSD_{.05}$ | 15 | 0.16 | 0.10 |
| $LSD_{.10}$ | 12 | 0.13 | 0.08 |

Table 4. Effect of different N management programs on corn yield, and ear leaf and grain N concentrations, 1987.

| Treatment | Yield | Ear leaf N | Grain N |
|---|---|---|---|
| | bu/A | ---------- % | ---------- |
| Check (no N) | 70 | 2.24 | 1.24 |
| Ammonia & UAN | 98 | 3.68 | 1.81 |
| UAN broadcast | 106 | 3.42 | 1.69 |
| UAN dribbled | | | |
| On ridge | 98 | 3.38 | 1.64 |
| Each furrow | 101 | 3.47 | 1.71 |
| Alternate furrows | 94 | 3.39 | 1.65 |
| UAN split | | | |
| Sidedress-ridge | 102 | 3.34 | 1.70 |
| Sidedress-furrow | 88 | 3.10 | 1.54 |
| $LSD_{.05}$ | 8 | 0.13 | 0.11 |
| $LSD_{.10}$ | 7 | 0.11 | 0.09 |

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